



## BUILDER GUIDELINES

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### INTRODUCTION

#### Purpose and Scope

This document provides general guidelines for builders enrolling in the American Lung Association's® Health House® program to improve indoor air quality in newly constructed homes. Both required and optional elements are included. Optional elements are upgrades that are recommended to enhance building performance. The guidelines are not intended to be inclusive of all details necessary in the construction of a new home. Builder guidelines for targeted climates in the United States (to be developed), will accompany this document to offer specifics on how builders can meet the requirements of this program in the country's major climate zones.

#### Mission

The American Lung Association's mission is to prevent lung disease and promote lung health. Because lung health begins at home, the American Lung Association Health House program's mission is to raise the standard of the way homes are built, renovated and maintained.

#### Acknowledgements

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**Disclaimer:** The American Lung Association® and its Health House® program can give no assurances and will not be held liable for the indoor air quality a home exhibits. Likewise, no assurances can be given that a person will feel better or have improved health while living in a house built according to American Lung Association® Health House® guidelines. Improved indoor air quality (IAQ) is not solely dependent on home construction techniques and materials. The indoor air quality within a home is also highly dependent on occupant lifestyle and household management practices, including the presence of secondhand tobacco smoke, the quality of air filters and frequency of filter changes, proper maintenance of heating, cooling, dehumidifying and ventilating equipment per manufacturer instructions, maintenance of sanitary conditions inside the house and other related factors.

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	<b>I. SITE</b>
1	Assess the site.
	Review ambient air quality records, previous uses, and current and planned use of adjacent property to identify potential sources of contaminants or other aggravating factors. Conduct water or soil sampling as needed depending on the information gathered.
2	Avoid problem locations.
	Avoid sites near landfills, highways, abandoned gas stations, floodplains and other uses that may cause air quality problems for the home.
3	Orient the building.
4	Use climatic tempering.
5	Use daylighting.
6	Prepare the site.
7	Manage on-site water.
8	Vegetation patterns indicate water flow and retention patterns on the site and the existence of water tables close to the surface; use this information to locate buildings and drainage features. If water accumulation is evident, locate the house on the driest portions of the site.
9	Design and implement drainage to manage site water.
10	Consider landscape design.
	Recommend species that are not allergenic and are pest resistant.
11	Use Integrated Pest Management (IPM). Make the building and site inhospitable environments for pest plants and animals.
12	Remove construction debris from the site (including stumps, branches or lumber).
13	Keep shrubs and bushes a minimum of 1-1/2 feet from the foundation.
	<b>II. BUILDING ENCLOSURE</b>
14	The entire building enclosure should meet an air leakage value of 1.25 square inches ELA per 100 square feet of building enclosure area or equivalent of 0.25 CFM per square foot of building enclosure area at 50 Pascal.
15	Provide general moisture control.
	Design the building enclosure to manage moisture migration so walls will dry to the interior, exterior or both (as indicated by local climate).
16	Provide building sections. Show liquid water barrier continuity around the entire building, including roofs, walls, windows, doors and foundations.
17	Provide typical details. Show liquid water barrier continuity at intersections between two or more building elements (e.g., windows-walls, skylight-roofs, roof-walls).
18	Provide 3D details. Show three-dimensional details when three or more elements meet (e.g., two walls and a roof, window openings, drain plane, cladding).
19	Provide proper foundations
20	Consider general foundation requirements.
21	Provide liquid water protection (prevent water entering the soil near the foundation from above, the side or below, and/or drain water away from the foundation).
22	Slope ground surface away from foundation 6 inches in ten feet. Over-fill in anticipation of settling.
23	Provide drainage for rainwater and groundwater. Adjust details of the drainage system based on soil testing and building design. For example, slab-on-grade foundations do not require footing drains but shall have grading and site work that will carry water away from the house.
24	Provide capillary breaks. Capillary breaks are barriers such as damp proof coatings and films or large-pored materials such as drainage mats or gravel beds (a layer of stone pebbles >1/2 inch diameter aggregate).
	All of these locations require capillary breaks:
25	Exterior surface of below-grade walls.
26	Beneath slabs.
27	Between sills and foundation materials.
28	Between footings and the materials they support. (e.g., foundation walls or exception to this would be slab on grade floors)
29	Install plastic or rubber films beneath slabs and on top of exposed soil.
30	Prevent condensation on earth-cooled concrete surfaces.
31	Insulate foundation walls and floors so that interior surface temperatures are above the dew point. Use materials that slow the rate of water vapor movement by diffusion and air transport through the insulation to the cool surfaces. (For example, extruded or expanded styrene insulation on a below grade foundation wall.)
32	Include any crawlspaces as part of the conditioned space; OR
33	Use EPA protocols for radon-resistant construction methods, including the following three elements:
34	Reduce air leakage paths between soil and indoor air.
35	Provide passive venting of an air-permeable drainage layer beneath slabs and alongside footings and vent vertically through the roof in accordance to EPA protocol.
36	Reduce depressurization of the building.
37	Use Integrated Pest Management methods to exclude pest entry.
38	Seal utility penetrations and joints between materials. Use filler strips of metal or wood or metal screens for larger openings. Use caulk or insulation materials for smaller openings.
39	Seal all openings larger than 1/4 inch with rodent and corrosion proof materials (e.g., copper or stainless steel mesh, concrete).
40	Apply termite shield between concrete and sill plate. The top course of concrete blocks in a stem wall shall be grouted solid.

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41	In areas of moderate and heavy termite infestation, the builder shall select a termite management contractor who uses integrated pest management methods.
42	Limit volatile organic compound (VOC) emissions from foundation materials.
43	Limit concrete sealants to those needed and use low-emitting or quick-curing sealants.
44	Any wood treated with site-applied liquid wood preservatives shall be isolated from building air (use a coating such as a plastic film or sealer if the treated wood is inside the building envelope).
45	Use vegetable based oil or polyethylene film as a release agent on concrete forms. (NOTE: This does not apply to insulating forms that remain in place).
46	Specific slab-on-grade foundation details.
47	Use a monolithic slab or seal the slab edge using elastomeric caulk and backer.
48	Seal control joints using elastomeric caulk and backer.
49	Provide insulation, drainage, damp-proofing, and capillary breaks appropriate for stem-wall and siding type and climate.
50	Seal around tub and shower traps using a plastic box as a form. Run the roughed-in plumbing into a plastic box (typically at least 12" x 12") that is cast into the slab. Remove the top of the box, leaving the rest in place. Seal around the pipes where they pass through the box perimeter.
51	Specific crawlspace foundation details.
52	Include any crawlspaces as part of the conditioned space.
53	The interior earth surface of the crawlspace must be level with or higher than the exterior finish grade.
54	Exclude burrowing rodents.
55	Extend footing 6 inches outward from the stem wall; OR
56	In existing buildings, install a two inch thick concrete floor.
57	Insulate foundation walls to meet Energy Star levels, at minimum.
58	Place vapor impermeable cover on the floor and install a passive radon control system.
59	Protect insulation from below with moisture resistant, pest-proof covering (e.g., fiber-cement board, galvanized insect screen).
60	Specific basement foundation details.
61	Follow guidance for crawlspaces. Basements are basically unvented crawlspaces, except when they are finished into living space. Framing and finishes require moisture protection.
62	Wall requirements.
63	Provide rain water drainage. Design exterior walls to intercept and drain rain water to the outside. (This is accomplished using cladding, air gaps and drainage material.)
64	Ensure permeability. Walls must be designed and constructed to dry to the interior, the exterior, or both, depending on climate conditions. (NOTE: Complete ASHRAE Addendum to be added to references.)
65	Provide pest control.
66	Seal gaps 1/4 <sup>th</sup> inch or larger, either in the cladding system or between the cladding and sheathing. Copper mesh is one possible sealing material.
67	In roach-infested areas, seal openings as small as 1/8 <sup>th</sup> inch in diameter. Select a durable layer of the enclosure—like the sheathing or interior finish—and seal joints, cracks and penetrations. Sealing interior walls is beneficial as well. Make targeted applications of boric acid dust.
68	Plumbing pipe location. Do not place plumbing pipes (supplies or drains) in exterior walls.
69	Wire penetrations. Avoid wire penetrations in exterior walls if possible; caulk gaps around unavoidable wire penetrations into exterior walls.
70	Insulation. Insulate exterior walls to at least meet Energy Star requirements.
71	Doors and windows.
72	Window selection. Use windows with a low potential for condensation.
73	Windows shall have a U value less than or equal to 0.40 and a SHGF less than or equal to 0.45, OR must be Energy Star or NFRC labeled.
74	Ensure proper installation. Install windows and doors to protect moisture sensitive materials from rainwater intrusion.
75	Install head flashing over tops of windows and doors.
76	Wrap shingled drainage paper into the rough opening on sides and bottom.
77	Install pan flashing at window bottoms.
78	Entryway.
79	Provide storage. Provide room to remove and store coats, shoes and boots. Entryways are also good places to store vacuum cleaners or locate a central vacuum port at this location.
80	Track-off system. Provide well drained, surfaced walkways and a track-off system including the following elements:
81	A permeable, rugged outdoor mat that collects gritty materials and allows dirt to fall through.
82	A rugged indoor mat that scrapes shoe soles and collects grit and water.
83	A hard-surfaced, easily mopped floor to collect very fine particles left by drying footprints.
84	Review attic.
85	Conditioned attics (inside the thermal enclosure).
86	If the attic is inside the thermal enclosure space, ductwork and air handlers can be located in the attic.
87	The attic enclosure (roof and gables) shall meet Energy Star insulation values. Verify air barrier location and durability. Seal ducts to ductwork specification in the mechanical equipment section. (See 228.)
88	Unconditioned attics (outside the thermal enclosure).
89	No air handlers or conditioning equipment shall be placed in unconditioned attics.

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90	Ductwork may be located inside the thermal enclosure but above a false ceiling; OR ductwork may be installed in unconditioned attics provided it meets the following requirements.
	a. Duct leakage to the outside shall be less than 3% of the conditioned floor area, in CFM and shall be measured during performance testing. The 3% includes leakage of the air handler unit when performance tested.
	b. Ducts shall be insulated to meet the insulation requirements for attic spaces climate.
	(NOTE: Exhaust systems that are part of the conditioned space ventilation system and ductwork that delivers outside air to the ventilation system may be placed in the attic as long as they meet the requirements in the mechanical section.)
	91 Insulate ceiling to Energy Star levels.
	92 Truss design shall allow full depth insulation to cover entire top plate. For hot-humid climates at least 2 inches (rather than full) covering the top plate is acceptable.
	93 All top plate penetrations shall be sealed.
	94 Seal any gaps to the outside greater than 1/4 <sup>th</sup> inch. Wire screen or metal mesh is good for this purpose.
	95 Review roof.
	96 Outside roof pitch.
	97 Pitched roofs shall have a slope of at least 3/12 <sup>th</sup> .
	98 Flat roofs shall meet these conditions:
	99 Slope shall be at least 1/12 <sup>th</sup> .
	100 Drains shall be at the lowest points on the roof and shall be located so that any leaks that develop do not soak moisture-sensitive materials.
	101 In climates where ice dams are a problem, locate drainage to prevent ice dams from developing. In areas that do not experience ice dam problems, flat roofs can drain to roof perimeters and into an exterior drainpipe system.
	102 Overhang dimensions. Overhangs must be wide enough to offer some protection to minimize the walls from wetting.
	103 Gutters and drains.
	104 Rainwater must be collected from the roof and delivered to a location that will continue to divert it away from the building. Dispose of it at or below the soil surface at least 4 feet away from the house.
	105 Gutters and downspouts must be large enough to handle the expected rainfall. Gutters should not drain into footing drains.
	106 Flashings. Flashings shall be properly designed and installed. Detail drawings must be prepared for intersections between different roof planes, roofs and walls and roof penetrations.
	107 Integrated Pest Management. Screen any gaps in the roofing system (including flashing, ventilation openings and corrugations) against rodents, bats and insects. Use metal to protect against chewing. Design screened vents for easy cleaning.
	108 Garage.
	109 Slope the garage floor toward the driveway OR slope to floor drain.
	110 Control Airflows. Minimize air movement from the garage into the house.
	111 Make the garage fully detached (simple and effective); OR
	112 Attached garages.
	113 No air handlers or ductwork in garage. (NOTE: Exhaust ducts are allowed in garages but must be air sealed to less than 5% loss.)
	114 Weatherstrip the door between the house and the garage, use spring-loaded hinges on the door, and air seal the common wall.
	115 Manage air pressures. Air seal the garage wall so that when the house is depressurized by 50 Pascals, the garage to house pressure (with all garage doors closed) must be at least 49 Pascals.
	Recommendation: In addition, it is recommended that one of the three strategies listed below is adopted:
	116 Exhaust ventilate the garage for 15 minutes at 250 CFM after the car has been started or turned off; OR
	117 Keep the house continuously pressurized (e.g., using fan-powered filtered outdoor air); OR
	118 Isolate the garage by creating a continuously-depressurized cavity between the house and garage.
	<b>III. FINISHES AND FURNISHINGS</b>
	119 General guidelines.
	120 Obtain, read and follow manufacturers' directions.
	121 Ease of cleaning, durability. Select products and materials for durability and ease of cleaning.
	122 Use hard-surfaced materials rather than textiles. If textiles are necessary, use textiles that can be cleaned in place or easily removed and cleaned.
	123 Use semi-gloss enamel instead of matte finishes.
	124 Avoid on-site mixing of products.
	125 "Age" products. Reduce VOC emissions by airing/ventilating the product. Ideally this "preconditioning" of the product (e.g., carpets, carpet cushions) can be accomplished by the manufacturer at the plant location or storage facility prior to delivery.
	126 Protect porous materials. Protect porous materials such as gypsum board and carpet from weather and from contaminants produced by sanding, welding, painting, pesticide application, and other construction activities.
	127 Isolate and ventilate. Isolate and ventilate during and shortly after the installation of materials and products that are strong sources of contaminants and are amenable to ventilation conditioning; that is, materials with high material-phase diffusion rates. These materials include:
	128 Gypsum board taping.
	129 Floorings.
	130 Paints, varnishes, adhesives and wall coverings.
	131 Flooring systems and floor coverings.
	132 Carpet products. Carpet and carpet pads can be used if they meet the following criteria:
	133 Carpet Rug Institute (CRI) IAQ label.

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134	Don't use wall-to-wall carpet in bathrooms, kitchens, utility rooms, basements or entryways.
135	Use 100% nylon yarn system, or polyester or wool pile.
136	Construction:
137	Nap height: less than 0.5 inch.
138	Installation.
139	Use tack strips to lay down carpet (no glues); OR, factory supplied non-wet, low VOC adhesive.
140	Provide permanent chemically welded seams and the alkalinity of the concrete meet the product manufacturer's specifications.
141	Urea-formaldehyde wood products are not to be used under carpets.
142	If a carpet product with any type of vinyl backing is laid over concrete, the slab must be tested to ensure that the moisture content and the alkalinity of the concrete meets the product manufacturer's specifications (NOTE: This applies to any flooring applied to concrete.)
143	If carpet is installed in over 70% of the floor area, a central vacuum system shall be installed and the installation vented to the outdoors (the system can be exhausted to home interior if the air is HEPA filtered or equal).
144	Concrete sub-floor. Concrete must meet the water vapor emission and pH levels specified by flooring product manufacturers. Test to confirm proper conditions before installing flooring products.
145	Hard-surfaced flooring. Instead of carpet, use hard-surfaced floors such as wood, stained concrete, ceramic or quarry tile, linoleum, vinyl.
146	Selection criteria. (NOTE: Some of the hard-surfaced floors are smooth enough to present slipping hazards.)
147	Use stone, Concrete Masonry Unit, concrete or ceramic flooring when possible.
148	Do not use linseed linoleum in ozone non-attainment areas.
149	Vinyl flooring: Use the highest grade of resilient flooring. The compounds of concern emitted by vinyl products (i.e., low volatility aromatics and phenols) are odorous at low concentrations.
150	Installation.
151	Attach wooden flooring mechanically (e.g., with nails) instead of using adhesive.
152	Vinyl flooring.
153	Source screen adhesives used to secure vinyl flooring.
154	Use new generation sheet flooring adhesive with very low VOC content. Apply in accordance with manufacturers' instructions. Adhesive should always be from freshly opened containers. Never use adhesive that has spoiled.
155	If vinyl flooring is laid over concrete, ensure that the moisture content meet the product manufacturer's specifications.
156	Paints and varnishes.
157	Use low VOC products. Recommend use of "zero" or "very low" VOC interior latex or 100% acrylic paint products for interior wall/ceiling applications. For wearability and durability products that meet these standards are recommended:
158	Greater than 1000 cycles on ASTM D2486 (scrubbing durability).
159	Greater than 50% stain removal on ASTM D3450 (washability).
160	Greater than 0.95 contrast ratio on ASTM D2805 (hiding power).
161	Varnishes. Use water based polyurethane varnishes.
162	Get Material Safety Data Sheets (MSDS). Get MSDS sheets and ask for more data as needed. Ask manufacturers to provide a listing of all contents of their products.
163	Avoid the following:
164	Paints with ethylene glycol (NOTE: Paints with propylene glycol are acceptable).
165	Follow specific ventilation guidance for paints, varnishes, adhesives, vinyl flooring and carpeting.
166	Existing ventilation system shall be operated at high speed for a minimum of 3 days before occupancy.
167	Ventilation can be fan powered or may use operable windows and doors.
168	Ventilation should be used during application, and for two days afterwards.
169	Do not use the air handling equipment to ventilate during construction unless main return trunk is disconnected and the remaining duct protected with a disposable filter with a minimum MERV 8 rating. Seal and protect ductwork and air handling mechanical equipment from contamination during construction activities.
170	Composite materials. (sub-floors, cabinet carcasses, counter tops, shelves)
171	Avoid composites in closet and cabinet shelves. Instead, use wire shelves OR solid or salvaged uncontaminated lumber. Use reclaimed stone, cementitious board or stainless steel for countertops.
172	Avoid composite materials in underlayments, cabinets and countertop base (e.g., substitute fiber cement board underlayment, metal or solid wood cabinets, or stone countertops).
173	If composites must be used:
174	Select composite materials that use phenol-formaldehyde or diisocyanate glues rather than urea-formaldehyde. Do not use cabinetry with acid-cured finishes; OR
175	Seal (e.g., with laminates or sealers) all the surfaces where urea-formaldehyde resins are present in the formula.
176	Composite products that meet HUD's formaldehyde emission standard do not require sealing or laminates.
177	Caulks and adhesives.
178	Use gaskets where feasible.
179	Select caulks and adhesives carefully. Use low emitting and low shrinkage caulks and adhesives. Select the lowest VOC caulks that can do the job. Use new generation "very low" VOC caulks or adhesives in all general-purpose applications. When possible, avoid use of products with toxic and/or odorous compounds. Water based adhesives are available. Apply caution when using specialty products in these categories. MSDS and product info should be scrutinized.

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180	Walls.
181	Vinyl wallpaper. Do not use vinyl wallpaper in hot humid or humid mixed climates.
182	Gypsum board.
183	Substitute cementitious board or fiberglass covered gypsum board for paper cove red gypsum board in wet areas (tub and shower surrounds).
184	Raise paper covered gypsum board 1/2 inch from concrete slabs on or below grade.
185	Planters. Avoid indoor planters/install drainage system if planters are used.
	<b>IV. MECHANICAL EQUIPMENT</b>
186	General Guidelines. Make equipment easy to use, easy to access, and easy to understand with clear instructions that are visible to the occupant.
187	Obtain, read and follow manufacturers' directions.
188	Equipment location and installation requirements:
189	Locate HVAC and dehumidification equipment inside the thermal enclosure (e.g., no air handlers in vented attics, vented crawlspaces or in garages).
190	Provide easy access to any components that will require cleaning, maintenance, removal, or replacement (e.g., access panels, hatches, filters and coils).
191	Equipment that condenses water (air conditioners, dehumidifiers) shall have adequate cleanout and positive drainage. Look for equipment and installations that meet these characteristics:
192	Drain pans should be sloped, corrosion resistant (e.g., stainless or plastic).
193	Drains should be located at the low point in the pans.
194	Disaster pans located below equipment in conditioned attics should have a water sensor to shut equipment down if drainage fails and pan starts to fill.
195	Panels should be large and easy to open.
196	Surfaces should be easily cleaned (no internal fibrous sound or thermal insulation).
197	Combustion appliances.
198	All combustion appliances (including furnaces, boilers, water heaters and fireplaces) shall be sealed combustion or power vented. Do not use any unvented gas appliances, including fireplaces, ranges, and ovens.
199	Install CO monitor that complies with Canadian Standard CSA 6.19. The best location for a CO monitor is in hallway outside of bedrooms.
200	Controls.
201	Controls for combustion and ventilation equipment shall be clearly labeled and operating instructions must be available. Graphic illustrations can be very useful in providing operating instructions. Put them on a brass plate and rivet it to the equipment.
202	Air handlers shall operate on time schedule as well as by thermostat control. Include at least a 2-minute time delay on air handler after a cooling run before fan switches off. This feature is not appropriate to hot, humid climate zones.
203	Ventilation.
204	General guidelines.
205	Ventilation rates:
206	Continuous general ventilation should be at least 1.0 CFM per 100 square foot of floor area plus at least 15 CFM for the first bedroom and 7.5 CFM for each additional bedroom. The ventilation system shall be capable of providing 2 times this amount.
207	Maintain local effective ventilation rates:
208	Rates should be at least 110 100 CFM intermittent per kitchen.
209	Rates should be at least 50 CFM intermittent or 20 CFM continuous in bathrooms/toilets.
210	Distribution: Outdoor air shall be distributed to or exhaust air drawn from at least three locations including all bedrooms. (This requirement can be met by placing inlets for a central exhaust system in three locations, including all bedrooms.)
211	Provide adequate mechanical ventilation.
212	Select fans that are quiet, energy efficient and long lasting.
213	Sound should be < 1.5 sones.
214	Power should be < 0.5 watts/CFM, (1 watt/CFM for HRV).
215	Flows rated at 0.2 inches WC shall be used to meet the design ventilation rates.
216	Air handlers.
217	Return flow must meet manufacturer's specs for air flow over coil.
218	Air handler closet shall be neutral or slightly positive with respect to unvented attic and neutral with respect to house.
219	Filters.
220	Filter hardware must be airtight. There shall be no leaks present in the filter rack and no filter bypass.
221	No intentionally produced ozone is allowed.
222	Compatibility: Filters must be specified for low-pressure residential use that is compatible with the air handler. Filter pressure drop shall be compatible with fan motor system, and initial pressure should be < 0.25 inches WC.
223	Filter efficiencies for recirculated air and fan powered outdoor air shall be: Minimum MERV 10
224	In EPA NAAQS ozone nonattainment areas, a three-stage filter system may be used: A very low efficiency pre-filter to block feathers, leaves, etc.; AND A 55% dust spot filter; AND A 2 inch deep carbon filter with associated pressure drop of no more than 0.15 inch WG at an approach velocity of 375 feet/minute. The filter shall have a minimum of 8 pounds of 60% activated, virgin coconut shell carbon for each 1,000 CFM of air. Filter cell should allow for an approximate 30% bypass to achieve the desired removal, and accommodate the lower pressure drop needed across the cell.
225	Air distribution.

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226	Vent exhaust fans to a terminal device outside the building enclosure using smooth, solid duct.
227	Locate outdoor ventilation air intakes (including dedicated passive ventilation inlets) at least 10 feet away from exhaust outlets, driveways, plants, and sources of heat or moisture.
228	All ducts will not have a total leakage more than 7% of the conditioned floor area at rough-in when all ducts are inside the thermal envelope. If ducts are outside the conditioned duct, leakage shall be limited to 3% of the conditioned floor area.
229	Seal all duct connections with mastic and mesh.
230	Seal supply diffuser boots to gypsum board using mastic or acrylic water-based caulk.
231	Return ductwork shall be made of materials that can be easily cleaned without damage to the integrity of the duct. If fiberglass duct board is to be used, it must have the surface in contact with the air stream polymer coated. Additionally, all cut ends must be sealed to preclude erosion by the air stream.
232	Use external insulation or hard-surfaced internal materials to control sound, heat transfer and condensation. Do not install fibrous insulation inside (air stream side) ducts (exception—supply diffuser housing may be coated or lined fibrous insulation).
233	Building cavities shall not be used as part of forced-air distribution system.
234	Rooms or zones shall not exceed +/- 2.5 Pascals relative to outdoors caused by the operation of any or combination of fans or blowers. Provide 50 square inches free return or transfer grille per 100 CFM of supply, and include free area under door as part of area.
235	Interzonal pressure differences shall be less than 3 Pascals.
236	Clothes dryers shall vent horizontally through walls to the outside using smooth solid duct and shall terminate at least 10 feet away from any outside air intake or air conditioning compressor. The seams shall be sealed with mastic. If they are to vent vertically, then an assist fan shall be hardwired to the dryer operation.
237	Kitchen ranges shall have exhaust hoods vented directly to the outdoors. The fan shall operate quietly, at less than 3 sones. Make-up air shall be provided if the exhaust is greater than 200 CFM.
238	Humidity control.
239	Maintain relative humidity below 60% year round. (Ideally, keep relative humidity below 50% to reduce the potential for mold growth and limit dust mite proliferation.)
240	Cooling systems shall be sized according to ACCA Manual J.
241	Central dehumidification systems shall have relative humidity control and are required in hot, humid climates.
242	Lighting guidelines. Recessed lights in insulated ceilings are only acceptable if they are air sealed and IC rated so they can be insulated. For ceilings under unvented attics, recessed lights if used should not be air tight rated.
243	Water treatment guidelines.
244	Remove chlorine compounds. If water is chlorinated, install an activated carbon filter to remove the chlorine compounds for any drinking or bathing purposes.
245	Store water treatment chemicals properly. Provide secure, isolated storage for water treatment chemicals.
246	Store chemicals properly guidelines. Provide secure, isolated, vented-to-the-outside, metal storage cabinets (located in detached garage if available) for storage of flammable and toxic materials.
	<b>V. COMMISSIONING</b>
247	HVAC system.
248	Measure airflows. Measure the flow rate of air handling equipment. Make adjustments and modifications as necessary to meet specified rates of + or - 10% as determined by Manual J room-to-room calculations.
249	Inspect air handling equipment. Look for debris and cleanliness during testing and balancing (TAB) and clean collected debris before start-up.
250	Seal ducts. Seal all ducts and air handlers to prevent contamination during construction.
251	Ventilate before occupancy. For the period between finishing and occupancy, ventilate the building at the highest rate the ventilation system can produce for a period of 3 days.
252	Provide owner's manual. Provide owners information including operating and maintenance instructions, assumptions about use and loads, specifications of equipment, and product information on all paints, adhesives, sealants, cabinetry and finishes. Require manufacturers of equipment and materials to provide maintenance instructions including IAQ impacts.
253	Provide "as built" (drawings) including HVAC design.
	<b>VI. CONSTRUCTION HYGIENE, SAFETY AND HEALTH</b>
254	Keep the site clean.
	Wall cavities
	Ducts
	Mechanical equipment

## VII. REFERENCES

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